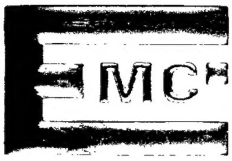

Executive Summary

FINAL REPORT

BIOMASS STUDY
PHASE II

for

FT. McCOY, WISCONSIN

Prepared for

UNITED STATES ARMY DISTRICT, OMAHA
CORPS OF ENGINEERS
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EXECUTIVE SUMMARY

0.1 INTRODUCTION

0.1.1 Objective

The objective of this study was to assess the economic feasibility of utilizing biomass fuel at Fort McCoy. This subject was addressed in the Energy Engineering Analysis Program (EEAP) report submitted by Energy Management Consultants, Inc. in October, 1981. In that report a preliminary analysis indicated that some life cycle cost savings could result from utilization of wood as a fuel at Fort McCoy; but refuse derived fuels (RDF) were eliminated from consideration. This study complements and expands upon that preliminary analysis.

0.1.2 Methodology

There are several possible schemes by which wood might be utilized as a fuel at Fort McCoy. Although one could show life cycle economic feasibility, another might not. Thus a fair assessment of the potential for biomass use at Fort McCoy requires a concurrent determination of what method of utilization would yield the greatest benefits under the conditions prevailing at that site. To directly address each conceivable possibility and develop its associated life cycle cost would entail a massive study with many unnecessary and repetitive analyses of similarly unattractive concepts. Therefore, in this study, the identification of an optimal utilization scheme was performed by addressing the possibilities categorically with the following sequence of questions.

- Which of the currently used fuels would be the best candidate for conversion to wood? (eg., coal, gas, oil)
- What utilization technology (fuel type (eg., sawdust, chips, pellets, etc.) and firing method (eg., direct combustion, gasification, etc.)) would be most appropriate for Fort McCoy?
- What would be the specific conversion requirements associated with implementing the selected biomass technology at Fort McCoy? And to what extent should it be implemented?
- What would be the most economical method of procuring biomass fuel?

Having resolved these questions, the selected options were consolidated into a composite conversion concept, and a life cycle economic comparison with the base case (no biomass utilization) performed.

The results of examining each of the above questions and the final economic comparison are briefly presented in the following summary.

0.2 EXISTING CONDITIONS

0.2.1 Facility Description

0.2.1.1 General

The 59,779 acre site on which Fort McCoy is located was originally developed as a military reservation and artillery range used by regular Army troops in the early 1900s. The status of the installation has changed over the years with changes in national defense needs and policies. Activity was escalated during World War II and the Korean conflict, with the base reverting to an inactive status at other times. The post was designated Fort McCoy in 1974, reflecting its status as a permanent military installation.

0.2.1.2 Mission

Fort McCoy is both a regional support center and a maneuver training base. A summary of the mission areas is as follows:

- Plan, coordinate, and furnish administrative, logistic, maintenance and training support, as directed by Forces Command (FORSCOM), for operation at Fort McCoy, in support of U.S. Army Reserve, Army National Guard, and other Reserve component units and activities utilizing Fort McCoy for Annual Training (AT) and Multiple Unit Training Assembly (MUTA). Provide equivalent support to elements of the Active Army utilizing Fort McCoy for field training.

- Provide related support to Reserve Component units during their Inactive Duty Training (IDT) period at home stations, and to Active Army Elements within the Fort McCoy area of responsibility.

- Manage, maintain, and provide security and protection of personnel, real property and contents, grounds, roadways, and utility systems within the Fort McCoy area of responsibility.

0.2.2 Fuel/Energy Considerations

Since 1978 the primary heating fuel used at Fort McCoy has been coal. In FY 1980 a program was initiated to replace a portion of the coal requirement with densified wood pellets. This program

followed a series of test applications of the wood pellets as a coal substitute at several Army installations including Fort McCoy, conducted by the Army Construction Engineering Research Laboratory (CERL). As a result of those tests and the subsequent limited use of wood pellets, an interest has developed at Fort McCoy to expand that use.

The initial objective sought in converting from coal to wood pellets was a reduction in particulate emissions from large boilers at Fort McCoy which were not in compliance with Wisconsin air pollution regulations. It was hoped that the conversion would eliminate any need for addition of particulate collection equipment to the boilers. After experience with burning the pellets, several other benefits were noted, including:

- Wood pellet fired equipment required significantly less manpower for cleaning and ash removal.
- Full steam production was achievable when using the pellets in the coal-designed equipment.
- Wood pellet fired equipment operated at a higher efficiency than the coal fired equipment.

In view of this background and the low initial cost required for conversion of coal fired equipment to operate on wood pellets, it was concluded that existing coal fired equipment would be the most appropriate candidate for conversion to wood.

0.3 BIOMASS UTILIZATION TECHNOLOGY

The alternative biomass utilization technologies possible for application at Fort McCoy include those options stemming from the variety in fuel types (pellets, chips, sawdust) and in firing methods (conventional direct combustion, fluidized bed, gasification, and pyrolysis). As pointed out previously a chief attraction of using pellets is the ease with which they can be substituted for coal. Since the utilization factors (avg. use/capacity) of heating equipment at Fort McCoy are typically quite low, the initial cost is a relatively important factor. This also affects the selection of firing methods, since implementation of any of the unconventional technologies would require installation of new equipment.

Based on estimated costs for such equipment and projected fuel efficiencies, costs, and O & M requirements a preliminary life cycle analysis was performed to quantify the relative economic impacts of converting to wood applying the various fuel type and firing options. This analysis substantiated the conclusion that conventional direct firing of wood pellets offers the most promise as an approach to biomass utilization at Fort McCoy.

0.4 CONVERSION CONCEPTS

In order to optimize the scheme for replacing coal with wood pellets at Fort McCoy, it was important to consider just what such a conversion would

require for the various sorts of coal fired equipment presently used there. Although a wide variety of coal fired equipment types exist at Fort McCoy, they can be grouped as follows:

1) Large boilers ($\geq 10^6$ Btuh input capacity) in permanently active (12 month) buildings.

2) Small boilers ($< 10^6$ Btuh input capacity) in permanently active (12 month) buildings.

3) Forced air furnaces in permanently active buildings. (Typical size is approximately 400 kBtuh).

4) Miscellaneous equipment serving the heating needs of buildings used only part of the year (e.g., buildings used for Annual Training (AT) or Multiple Unit Training Assembly (MUTA) Training).

Based on detailed analyses of the life cycle costs of converting representative buildings from each of these categories to wood pellets, it was determined that only categories 1 and 2 would offer potential savings. Thus, the concept of biomass utilization at Fort McCoy was refined to include conversion of only the active boilers in 12-month buildings. This amounts to 36 boilers.

0.5 FUEL PROCUREMENT

Having defined optimal limits on the extent of conversion to wood in the concept analysis and evaluation, it was determined that about 31,000 mBtu of input energy would be required annually to supply the converted equipment. Since nearly 51,000 mBtu are projected to be annually available from scrub oak harvested from on-base forests, the possibility of processing this raw material into pellets on-base was considered. Also addressed was the possibility of purchasing wood wastes from local forest product operations, and processing it on-base. The final procurement option was to directly purchase pellets from bulk suppliers as is currently done.

Based on a life cycle analysis of these options it was determined that direct purchase of pellets at $66.60/ton (delivered at Fort McCoy) would be the most economical alternative. ($66.60/ton is the current rate paid by Fort McCoy for wood pellets).

0.6 OVERALL ECONOMICS

The prior steps in the analysis resulted in the formulation of a biomass utilization concept wherein 36 currently active coal fired boiler systems in permanent (12-month) buildings are to be modified as necessary to fire wood pellets purchased in bulk and delivered to Fort McCoy. This concept was developed to represent the greatest potential biomass utilization scheme applicable to Fort McCoy. Thus, by comparing its life cycle economics to those of the base case, the economic feasibility of biomass utilization at Fort McCoy was evaluated. The following table presents a breakdown of the economic values so obtained.

TABLE 0.1

LIFE CYCLE ECONOMIC SUMMARY
FOR COMPOSITE CONVERSION CONCEPT
FOR FORT McCOY

	Coal Firing (Base Case)	Wood Firing
Capital Cost Estimate:	$ 93,270*	$189,760
Annual Operating Cost:		
o O&M	132,179	35,205
o Fuel		
- Coal Purchase	47,276	-
- Coal Transportation	30,251	-
- Wood Purchase	-	86,490
- Wood Transportation	-	37,120
o Subtotal	209,706	158,815
Life Cycle Operating Cost		
o O&M	1,199,800	319,560
o Fuel		
- Coal Purchase	734,300	-
- Coal Transportation	674,500	-
- Wood Purchase	-	1,343,450
- Wood Transportation	-	827,700
o Subtotal	2,608,600	2,490,710
Total Life Cycle Cost		
o Capital Cost	93,200	189,760
o Operating Cost	2,608,600	2,490,710
o Total Cost	2,701,800	2,680,470

*Required for pollution control equipment when coal is used.

0.7 CONCLUSIONS/OBSERVATIONS

The life cycle savings projected for the biomass utilization concept characterized in Table 0.1 on page ES-5 indicates marginal economic feasibility. This concept encompasses a conversion to wood pellet firing of all active solid fueled boilers in permanent (12 month) buildings at Fort McCoy. Several aspects of the analysis leading to the economic projection associated with this conversion should be noted.

First, a significant credit to the economics of the proposed conversion arose from the fact that $96,010 has already been expended on conversion to wood pellets. This was the sum spent in initiating the current pellet program.

Secondly, the single most significant contribution to life cycle savings of the conversion stems from the substantial reduction in operational manpower requirements. As shown, a 73% reduction in O&M costs is projected to result from conversion to wood pellet firing (coal: $1,199,800, wood: $319,560). This massive reduction is primarily attributable to two differences between the base case of coal usage and the proposed wood pellet operation.

- The coal operation uses firing crews to manually fill stoker bins while automatic augers are projected for use with wood pellets.
- The cleaner and more complete combustion of wood leads to an estimated six-fold reduction in ash removal and related operational tasks.

It is noted that the life cycle manpower cost associated with manually filling the coal stoker bins in the base case is approximately $450,000 (38% of the total O&M). This represents operation of all 36 boilers comprising categories 1 and 2, or an average of $12,500 per boiler. Therefore, if the stoker bins of these boilers were to be filled with coal automatically, $12,500 in manpower costs would be saved over the life cycle of each one. A portion of this savings would be nullified by the initial cost of automating. Conservatively estimating this cost at 2.5 times the corresponding cost for automating the wood pellet bin filling operation (costs for day silos, augers, controls, and installation labor) a value of $7,600 per boiler is obtained. This would imply a $176,400 decrease in the base case life cycle cost as shown below:

$$\$450,000 - (36 \times \$7,600) = \$176,400$$

This reduction would shift the results of the life cycle cost comparison, so that the net difference between base case and wood pellet alternative would be 6 percent, favoring the base case (i.e. coal: $2,525,400, wood: $2,680,470).

Another factor significantly affecting the economic comparison of Table 0.1 is the current coal cost of $55.10/ton, $21.50 of which is transportation cost from Kentucky. If Illinois coal were utilized the transportation distance could be roughly halved. Conservatively estimating a corresponding 25% reduction in transportation cost (yielding $16.13/ton) the resulting total coal cost of $49.73/ton would reduce the total base case life cycle cost by $168,449. Again, this would reverse the economic indications of the life cycle cost comparison (base case: $2,533,400, wood pellet alternative: $2,680,470) to favor the base case by nearly 6 percent.

It is noted that currently the wood pellets used at Fort McCoy are transported from Virginia, Minnesota. This represents about half the distance the Kentucky coal is transported. However, the relative transportation costs of the two fuels are nearly equal due to the expense of special covered rail cars required by the wood pellets.

It is also noted that the requirement for pollution control equipment assumed to affect the base case was only marginal for four of the applicable boilers. The four active boilers greater than 1 mBtuh capacity which were constructed before April 1, 1972 were estimated to emit .63 lbs of particulates per pound of coal burned. But for these boilers the limit on allowable emissions is .60 lbs/mBtu. Since the estimate is so close to the limit, only a slight improvement in coal characteristics (such as a reduction in moisture content) would bring these boilers into compliance without new collection equipment. However, even if the cost of this equipment (about $9,300 per boiler) were deducted from the base case life cycle cost, the resulting total ($2,664,492) would still be within 6% of the total life cycle cost of the biomass alternative (although the base case would be the lower value).

In view of the results of Table 0.1 on page ES-5 and the above considerations, the general conclusion regarding the feasibility of biomass utilization at Fort McCoy is as follows. On a life cycle economic basis, no dramatic difference (greater than 10%) separates the conversion option from the base case, even when the above sensitivities are considered. Thus attention to other factors would be appropriate in deciding whether to implement the proposed conversion. It is noted that a preference for wood-pellet use exists among many Ft. McCoy personnel due to its cleanliness as compared to coal. In addition, the efficiency increase from 60% to 67% associated with the conversion to wood-pellets implies a source energy savings of about 3,600 mBtu per year. Thus the conversion represents a contribution toward both the national objectives to reduce source energy consumption and utilize renewable energy sources.